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Urinary Incontinence in Female Athletes: Prevalence, Mechanisms, Risk Factors and Management. A Narrative Review

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Abstract

Background. While urinary incontinence (UI) frequently affects active women, it is markedly more prevalent among competitive athletes. Repeated impacts and heavy external loads elevate intra-abdominal pressure beyond the counter-force capacity of the pelvic floor. The condition remains systematically under-reported.

Aim. To synthesise evidence (2019–2026) on prevalence, mechanisms, risk factors, and management of UI in competitive female athletes.

Material and methods. A narrative review of observational studies and intervention trials in athletic populations indexed in PubMed, Scopus, Web of Science, and SPORTDiscus. Data were synthesised thematically.

Results. Prevalence ranged from ~26% to >80%, varying by case definition. Leakage clustered during tasks generating steep pressure transients: landings, jumps, tackles, and heavy lifts. Age and parity were the most frequent correlates, though not in every cohort; years of training were not. Cumulative loading, rather than acute fatigue, was associated with symptom onset. Pelvic floor muscle training (PFMT) reduced leakage without requiring gains in maximal strength, whereas a coach-delivered programme lacking professional guidance did not.

Conclusions. Athletic UI is highly prevalent, under-reported, yet modifiable. Routine screening and professionally guided PFMT are warranted.

Key words: urinary incontinence; female athletes; pelvic floor muscles; intra-abdominal pressure; stress urinary incontinence.

1. Introduction

The International Continence Society defines urinary incontinence (UI) as any involuntary loss of urine. Its commonest subtype, stress urinary incontinence (SUI), is provoked by physical exertion, sneezing or coughing, which places sport among its triggers [1]. UI has long been framed as a condition of parous, peri- and postmenopausal women, yet it is reported by young, nulliparous and well-conditioned athletes at rates matching or exceeding general-population estimates [2,3]. Fitness therefore does not protect the pelvic floor, and the disciplines in which leakage is most often reported are also those that load it hardest.

Continence during exertion depends on the pelvic floor muscles (PFM) holding the urethra closed against rapid rises in intra-abdominal pressure (IAP). Sport generates such rises repeatedly, through ground-reaction forces in jumping, landing and tumbling, or through abdominal bracing and the Valsalva manoeuvre during heavy lifting [4]. Where the pressure transient outstrips the counter-pressure the PFM can produce, and produce in time, urine escapes. Whether the deficit lies in force, in timing, or in the passive support of the surrounding connective tissue is disputed, and the answer is not the same in every cohort [2,5].

Prevalence tracks the mechanical profile of the sport more closely than the profile of the athlete, and it stays high in elite cohorts [6]. Impact-dominated disciplines report the largest burden: artistic and rhythmic gymnastics and cheerleading [7,8], rugby [9], and track and field, where the figure shifts with event specialisation [10]. Load-dominated sports are not spared. Comparable rates come from CrossFit [11–13], powerlifting [14] and weightlifting [15–17]. Nor are symptoms confined to adults or to women who have given birth: they appear in adolescent athletes early in their training histories [18].

How training acts on the pelvic floor remains open. Habitual loading might strengthen the PFM and sharpen the timing of their contraction; equally, chronic exposure to high IAP might overload and weaken them. Neither account has been settled, and the available evidence does not support a causal reading in either direction [2,19]. What is established is narrower: a single bout of heavy lifting does not measurably impair PFM function in trained nulliparous women [4], which speaks to acute tolerance and not to the effect of years of loading. Risk is shaped in addition by sport history and by variables that have nothing to do with sport, among them body mass index and parity [15,16].

The cost is clinical and social at once. Leakage interrupts training, alters how a movement is executed, and is reported by athletes as affecting competition. It also produces embarrassment and avoidance, and it goes largely undisclosed: knowledge of pelvic floor anatomy among athletes is poor, and admitting to the symptom runs against expectations about what an athlete complains of [3,20].

The condition nonetheless responds to treatment. PFMT and conservative rehabilitation are the first-line options in the general female population, and the athlete-specific evidence, limited as it is to a handful of small and heterogeneous trials, points the same way [21–23].

The literature is fragmented in ways that carry practical consequences. Two meta-analyses of the same CrossFit population, published within a year of one another, report pooled prevalences of 44.5% and 32.1% [24,25]; the gap owes more to eligibility criteria and case definition than to any difference between the women studied. Epidemiological, mechanistic and therapeutic findings are also seldom brought together. This review therefore synthesises evidence published between 2019 and 2026 on the prevalence of UI in competitive female athletes, on the mechanisms proposed to explain it, on the factors that modify risk, and on what conservative treatment achieves. Throughout, UI in athletes is treated as a common, under-reported and treatable condition arising where sport-induced IAP exceeds what the pelvic floor can counter. That mechanism is an inference: none of the studies reviewed here measured IAP during sport directly.

2. Research materials and methods

This is a narrative review. The studies it draws on differ too widely for statistical pooling: cross-sectional surveys, laboratory assessments of pelvic floor function and a small number of intervention trials use different case definitions and different outcome instruments, and pooling them would impose a uniformity the data do not have.

2.1. Search strategy and information sources

PubMed/MEDLINE, Scopus, Web of Science and SPORTDiscus were searched. Four conceptual blocks were combined with AND, and terms within each block with OR: population ("female athlete", "women athlete"); exposure (weightlifting, powerlifting, CrossFit, gymnastic, rugby); outcome ("urinary incontinence", "stress urinary incontinence", "pelvic floor disorder"); and mechanism ("intra-abdominal pressure", "pelvic floor muscle"). Controlled vocabulary terms were used alongside free-text terms wherever the database supported them. Reference lists of the included reviews and primary studies were then checked in both directions, backward and forward, for records the database search had missed.

2.2. Eligibility criteria and study selection

Eligible participants were female athletes, adult or adolescent, training or competing at a competitive or high-intensity recreational level in disciplines involving repeated impact loading, heavy external loading, or both. Mixed-sex cohorts qualified only where female-specific data could be extracted separately. Non-athletic clinical populations were excluded, except where they supplied dose-response or mechanistic information on PFMT that was unavailable in athletic samples; such data are identified as extrapolated at the point of use. Eligible outcomes were the prevalence or severity of UI and SUI, pelvic floor morphology and function, IAP during sporting tasks, intervention effect, and psychosocial variables such as knowledge and help-seeking. Observational studies, intervention trials and reviews were all admitted.

The search was limited to publications from 2019 onwards, the point at which research on high-intensity functional training in women expanded and the first athlete-specific trials appeared. Records were deduplicated, screened on title and abstract, then read in full. Twenty-eight publications remained. The corpus is not uniformly competitive. Several of the largest cohorts, in particular those recruited through CrossFit and functional fitness gyms, consist of women training hard without necessarily competing, whereas the powerlifting, weightlifting, gymnastics, track-and-field and team-sport cohorts are made up of registered competitors. Extending the findings of the first group to competitive populations assumes that mechanical exposure, and not competitive status, is what matters; the assumption is stated wherever it carries weight.

2.3. Data synthesis

Authors, year, country, design, athletic exposure, sample size, demographic variables, outcome instruments and principal findings were extracted into a matrix (Table 1). The evidence was then synthesised thematically across the five domains that structure Section 3. Prevalence estimates are reported together with the instrument and case definition that produced them, since the figure means little without them.

No meta-analysis and no formal risk-of-bias scoring were undertaken, as neither fits a narrative design. Methodological limitations are raised instead where the study is cited, and drawn together in Section 4. Where findings conflict, the conflict is reported and, where the studies allow it, traced to differences in method rather than smoothed over.

3. Research results

The evidence is presented across five thematic domains: the prevalence of UI in different sports, the biomechanical relationship between IAP and pelvic floor function, the risk factors that modify that relationship, the conservative interventions tested to date, and the knowledge and psychosocial dimensions that govern whether symptoms are disclosed at all. Prevalence figures are reported alongside the instrument and case definition that produced them, because the two are inseparable in this literature. The characteristics and principal findings of the 28 included publications are collated in Table 1 at the end of this section.

3.1. Prevalence of urinary incontinence across sports

UI, and particularly SUI, demonstrates substantial prevalence across all examined athletic disciplines. The reported frequencies consistently surpass those anticipated in young, nulliparous cohorts, frequently approaching or exceeding general-population estimates for adult women. Discrepancies between cohorts appear to be primarily governed by the mechanical profile of the sport rather than the demographic characteristics of the athletes.

A robust cross-disciplinary estimate derives from a cohort of 754 elite Spanish athletes. Utilising the ICIQ-UI-SF, 3IQ, and Incontinence Severity Index, overall UI prevalence was documented at 33%. Notably, female athletes were 5.45 times more likely to be affected than their male counterparts (45.1% versus 14.7%, $p < 0.001$). SUI constituted the predominant subtype (59.9%), with symptoms classified as moderate to severe in 30.9% of cases. Furthermore, 22.7% of affected individuals experienced leakage during training sessions, most frequently elicited by jumping mechanics (40.5%) [6].

Impact-dominated disciplines consistently report the highest epidemiological burden. Within a sample of 319 artistic gymnasts, team gymnasts, and cheerleaders, UI and SUI were reported at 67.4% and 63.0%, respectively. Prevalence rates closely mirrored the frequency of high-impact acrobatic elements and landing surfaces: team gymnasts (83.6%), artistic gymnasts (70.6%), and cheerleaders (51.9%) [8]. Similarly, over half (54%) of nulliparous university rugby players reported exertional leakage [9]. Track-and-field cohorts exhibit comparable trends. Among national-level Spanish track-and-field athletes screened with the ICIQ-UI-SF, UI affected 51.7% of women against 18.8% of men [10]. A separate Spanish cohort of 255 female athletes, questioned about symptoms rather than screened with a diagnostic instrument, reported urinary leakage at a numerically similar 51.8% [20]; the two estimates rest on different case definitions, and the sex comparison derives from the former study alone. While rhythmic gymnastics demonstrated a relatively lower prevalence (31.8% in nulliparous adolescents), this rate remains substantially elevated compared to normative adolescent data [7].

Symptom onset is highly task-specific. In gymnastics, take-offs and landings provoked leakage in 67% and 60% of symptomatic athletes, respectively, compared to a mere 4% during running [8]. Rugby players experienced leakage predominantly during match play (90%) and tackling (88%), highlighting how abrupt, unpredictable contact precludes anticipatory PFM contraction [9]. In track and field, specialisation was not associated with UI as captured by questionnaire, with one exception: athletes specialising in vertical jumps showed a significantly lower prevalence than those in horizontal jumps, middle-distance running, and sprint/hurdles events, and also trained on the fewest days per week. The underlying gradient, highest in horizontal jumps and then in combined events and sprint/hurdles, is consistent with high ground-reaction forces at heel strike, but the confidence intervals are wide and the ranking itself did not reach significance [10].

Load-dominated disciplines impose a comparable burden. The CrossFit literature yields heterogeneous estimates strictly dependent on diagnostic thresholds: ranging from 26.1% when moderate bother was required [12] to 84% when all symptomatic severity was encompassed [11]. Where the bother threshold was applied across the whole spectrum of pelvic floor disorders, the overall burden in these athletes approached general-population expectations, and only bothersome UI in women under forty stood out; had mild bother counted as positive, the UI figure would have risen to 52% [12]. CrossFit participation significantly amplifies incontinence severity independently of parity [11,13]. Competitive powerlifting and weightlifting cohorts report prevalent leakage clustering around maximal or submaximal compound lifts, most notably the deadlift and back squat, with symptoms frequently exacerbating during high-repetition sets [14,15,17]. Weightlifting-specific lifts behave differently: in a French cohort assessed on the snatch and the clean and jerk, leakage was reported by 60.7% of athletes but was unrelated to the maximal load moved [16].

Methodological heterogeneity profoundly impacts prevalence reporting. A meta-analysis by Domínguez-Antuña et al. [25] established a 44.5% pooled UI prevalence in CrossFit, whereas Álvarez-García and Doğanay [24] reported 32.1% with extreme statistical heterogeneity (I^2 = 96.1%). Studies employing standardised pad tests systematically report the lowest prevalences, likely because controlled testing environments fail to replicate the specific mechanical triggers encountered in training [24]. The two reviews drew on partly overlapping primary literature but applied different eligibility criteria and pooled different case definitions, which accounts for much of the twelve-point gap between them. The variance is therefore best read as methodological divergence rather than as genuine epidemiological disagreement.

3.2. Mechanisms: intra-abdominal pressure and pelvic floor muscle dysfunction

The underlying pathomechanism is fundamentally governed by a biomechanical balance of forces. During a landing phase or a braced lift, downward vector forces - compounded by jump height, body mass, and voluntary abdominal bracing - exert significant pressure on the bladder and pelvic floor. The PFM and urethral sphincter must generate a proportional opposing counter-force. Leakage ensues when the descending mechanical load acutely exceeds the maximal continence threshold of the sphincter complex [13]. This biomechanical model elucidates why symptoms cluster during tasks characterised by steep pressure transients. It is, however, an inferential model: none of the included studies recorded IAP directly during sporting tasks, and the pressure-to-counter-force mismatch is reconstructed from the distribution of symptoms and from laboratory measures of pelvic floor function.

Interestingly, an acute bout of heavy resistance training (squats and deadlifts at 75–85% of one-repetition maximum) did not induce measurable muscular fatigue, altering neither PFM resting pressure nor contractile endurance in trained nulliparous women [4]. Thus, PFM function does not simply mirror peripheral muscular fatigue.

Structural and morphological investigations reveal a more complex aetiology. Berube and McLean [5] demonstrated that incontinent runners actually possessed a higher rate of force development during maximal PFM contraction compared to continent controls. However, the incontinent cohort exhibited diminished passive tissue stiffness and a lower resting bladder neck position, while the levator hiatus and the urethral wall tended to be larger without reaching statistical significance. These findings suggest the functional deficit resides primarily within the passive support structures - specifically the viscoelastic properties of the levator ani and associated connective tissues - rather than in active contractile force. Consequently, clinical assessments demonstrating high voluntary PFM strength do not preclude the presence of severe exertional dysfunction.

Cumulative loading, rather than acute fatigue, is what tracks with symptom burden. In a rugby cohort, each additional weekly training hour was associated with a 15.3% higher risk of incontinence, although the cross-sectional design records an association at one point in time and cannot establish that risk accrued over the training history [9]. A prospective observation points the same way: in the untreated control arm of a pilot randomised trial, the proportion of elite volleyball players leaking on a pad test rose from 50.0% to 83.3% across a four-month training macrocycle, although that arm comprised only six athletes and the observation is therefore suggestive rather than confirmatory [23]. Together these findings locate the relevant exposure window in the training macrocycle rather than the single session, without demonstrating pelvic floor muscle fatigue as the mediating mechanism.

3.3. Sport-specific risk factors

Risk stratification is modulated by a complex interplay of demographic, obstetric, and athletic variables. Age, parity, and vaginal delivery are the most consistently reported predictors of UI incidence and severity [11,25]. Their influence is not uniform, however. In master weightlifters, body mass index, previous pregnancies and depressive mood raised the odds of moderate or severe UI, whereas age and menopausal status did not [15], and in high-level rhythmic gymnasts none of the anticipated risk factors reached significance [7]. Obstetric and demographic history is therefore best read as a strong but not invariable modifier, whose weight depends on the age range and parity distribution of the cohort sampled.

Athletic exposures, conversely, exhibit less linear dose-response relationships. While training volume correlates with symptom onset in specific sports [9], cumulative years of resistance training and absolute maximal lifted loads frequently fail to associate with UI severity [16,17]. Prior participation in high-impact sports constitutes an independent risk factor, whereas previous strength-sport participation does not; in the same cohort, however, the predicted probability of moderate or severe UI rose with weekly hours of weightlifting training, so current training load and lifetime exposure should not be conflated [15]. Ultimately, acute loading characteristics and specific movement biomechanics appear to discriminate risk more sharply than cumulative years of athletic participation.

3.4. Management and interventions

Conservative pelvic-floor rehabilitation constitutes the primary therapeutic paradigm. Two athlete-specific randomised controlled trials demonstrated significant symptom amelioration, although they diverge on the contribution of muscle strength. A sixteen-week periodised PFMT intervention in elite volleyball players significantly reduced urine loss on the pad test and simultaneously raised maximum voluntary contraction, while vaginal resting pressure remained unchanged [23]. A parallel intervention in CrossFit participants yielded comparable symptom improvements without modifying maximal strength or endurance [26]. Read together, these findings indicate that symptom relief in athletes does not require gains in maximal force, and that enhanced neuromuscular timing, coordination, and anticipatory activation are plausible mediators; both trials are small, however, and the mechanism has not been tested directly.

Professional guidance emerges as a plausible determinant of intervention success. Among the trials appraised by Demeco et al. [22], the only programme delivered without professional input, a twelve-week coach-led Kegel intervention in nineteen gymnasts, produced no improvement. Guidance need not imply continuous on-site supervision: several of the positive athlete-specific studies were home-based programmes supported by written or filmed instruction and periodic professional contact [21,26]. Evidence extrapolated from clinical populations further indicates that high-frequency PFMT, particularly when embedded within dynamically loaded trunk stabilisation tasks, yields superior outcomes compared to isolated, low-frequency contractions [27]. The protocol underlying that trial combines pelvic floor activation with diaphragmatic breathing and transversus abdominis recruitment under load [28]. It was tested in a non-athletic clinical population, so both its dosing and its integration into loaded movement remain extrapolations awaiting confirmation in athletes.

3.5. Knowledge, awareness and psychosocial impact

A persistent epidemiological gap exists between symptom prevalence and clinical disclosure rates, driven predominantly by pervasive deficits in health literacy. Anatomical knowledge remains remarkably poor; in one cohort, 41.4% of gymnasts and cheerleaders were entirely unaware of the pelvic floor musculature, despite 73.7% expressing high willingness to engage in targeted training [8]. This knowledge deficit strongly correlates with the internalisation of gender stereotypes and a pronounced reluctance to seek professional medical care [20].

Consequently, athletes disproportionately rely on suboptimal containment strategies - such as pre-emptive voiding, fluid restriction, and wearing dark clothing - rather than engaging in evidence-based rehabilitation [3,13]. The profound psychosocial impact, characterised by embarrassment, fear of visible leakage, and avoidance behaviours, is frequently undetected by generic quality-of-life instruments. The resulting gap between symptom burden and clinical contact is stark: of fifty-one rugby players reporting leakage, one had consulted a health professional and none had received treatment, even though a proportion expressed interest in it [9]. Symptoms are thus normalised within sporting cultures and remain largely invisible to sports medicine services, which seldom screen for them [1].

Table 1. Characteristics and principal findings of the studies included in the review, in alphabetical order. Numbers in square brackets refer to the reference list.

Study	Design and population	Sport / exposure	Outcome measure	Principal findings
Álvarez-García and Doğanay [24]	Systematic review and meta-analysis; 13 cross-sectional studies, n = 2,187 (UI) and n = 1,323 (SUI)	CrossFit	Mixed (ICIQ-SF, ISI, pad test, ad hoc)	Pooled UI 32.1% (95% CI 22.2–43.8), SUI 35.8% (19.4–56.4); I^2 = 96.1% and 97.2%; age, parity and vaginal delivery explained heterogeneity in UI (R^2 = 0.52) but not in SUI; subgroups 27.4% vs 52.1%; pad-test studies gave the lowest figures.
Berube and McLean [5]	Cross-sectional laboratory comparison; 19 incontinent vs 20 continent runners	Running	Intravaginal dynamometry in standing; 2D/3D transperineal ultrasound	Incontinent runners showed a higher rate of force development during contraction (d = 0.40) and greater bladder neck elevation (d = 0.50), but lower passive stiffness (d = 0.80) and a lower resting bladder neck; the levator hiatus and urethral wall tended to be larger without reaching significance. The deficit lies in passive support, not active force.
Bø and Nygaard [2]	Narrative review	Physical activity, general	-	Formulated the two competing hypotheses: a training effect strengthening the pelvic floor muscles versus an overload effect of chronic high intra-abdominal pressure.
Bø et al. [19]	Scoping review	Strenuous physical activity	Pelvic organ prolapse	Available evidence judged insufficient to establish a consistent causal relationship between strenuous activity and pelvic organ prolapse.
Bø et al. [21]	Case series; 3 nulliparous women aged 21–32 y	Powerlifting and weightlifting	ICIQ-UI-SF	Twelve weeks of home-based PFMT with weekly physiotherapist follow-up: one athlete improved beyond the minimal clinically important change of 2.5 points, one improved below it, one worsened. Presented as evidence of feasibility, not efficacy.
Bosch-Donate et al. [20]	Cross-sectional anonymous online survey; 255 female athletes, Spain	Athletics (track and field)	PFD knowledge questionnaire; symptom report; gender-stereotype beliefs	Knowledge was low for pelvic organ prolapse (52.5%), anal incontinence (64.0%) and sexual dysfunction (40%), but not for urinary incontinence (70.8%); 51.8% reported urinary leakage. Symptomatology was not associated with level of knowledge, whereas lower knowledge was associated with more stereotyped beliefs and with rejection of professional care for pelvic floor dysfunction.
Culleton-Quinn et al. [3]	Systematic review; 32 studies from 14 countries, published 1994–2021	Elite female athletes, mixed sports	Mixed	Five themes: triggers, management, quality of life, performance, emotions. Strategies reported in 23 studies, dominated by containment and avoidance, with PFMT in only 7; quality of life unaffected in 16 of 18, performance affected in 11 of 12; emotions captured in only 9 (28%); 31 of 32 studies quantitative, none qualitative alone.
Demeco et al. [22]	Systematic review; 6 studies, 131 athletes,	Mixed (volleyball,	Leakage, maximum	Conservative management reduced leakage and improved maximum voluntary contraction; no meta-

Study	Design and population	Sport / exposure	Outcome measure	Principal findings
	mean age 23.19 y (3 RCTs at low risk of bias on PEDro; 3 observational, NOS 4/9)	gymnastics, sports students)	voluntary contraction	analysis possible owing to heterogeneity. Every trial producing benefit was physiotherapist-supervised, whereas a coach-delivered 12-week Kegel programme in 19 gymnasts produced no improvement.
Domínguez-Antuña et al. [25]	Meta-analysis; 13 cross-sectional studies, 4,823 women aged 18–71 y	CrossFit / high-intensity functional training	Mixed	UI prevalence 44.5%; SUI the most frequent type (81.2%); symptoms predominantly mild (55.3%) or moderate (40.7%); age, body mass index and parity increased the likelihood of UI; jump-based exercises most commonly implicated.
Elks et al. [11] - SUCCeSS	Cross-sectional survey; 423 women (322 CrossFit, 101 non-CrossFit group fitness controls)	CrossFit	ISI, UDI-6, POPDI-6	Any UI 84% vs 48%; moderate or severe 40% vs 14%; SUI 73% vs 47%, UUI 55% vs 42%, MUI 50% vs 31%; UDI-6 20.8 vs 12.5; POPDI-6 not different. CrossFit added 0.57 ISI points, equivalent to about 11 years of ageing, and was additive with vaginal delivery. Double unders provoked leakage in 65%; coping: pads 44%, pelvic floor exercises 36%.
Gram and Bø [7]	Cross-sectional; 107 nulliparous high-level gymnasts, mean age 14.5 y	Rhythmic gymnastics	ICIQ-UI-SF	UI 31.8%, predominantly SUI (61.8% of cases); leakage small in amount in 88.2%; mean score 4.7; 70.6% reported an effect on sports performance; 69.1% had never heard of the pelvic floor. None of the anticipated risk factors (low BMI, hypermobility, menarcheal status, disordered eating, training hours) reached significance.
Hagovská et al. [28]	Published protocol of the PELSTAB randomised trial	Non-athletic women with SUI	-	Source of the core-stabilisation PFMT protocol subsequently used in PELSTAB: pelvic floor activation embedded within loaded trunk tasks, with diaphragmatic breathing and transversus abdominis activation.
Hagovská et al. [27] - PELSTAB	RCT; 71 of 86 enrolled women randomised, 68 completed; intention-to-treat analysis	Non-athletic clinical population (evidence extrapolated)	ICIQ-UI-SF, perineometry, I-QoL, PGI-I, transperineal ultrasound	High- versus low-frequency PFMT with core stabilisation (approximately 900 vs 180 contractions weekly): incontinence episodes fell by 7.9 vs 3.0 per week (10.2→2.3 vs 9.3→6.3); ICIQ-UI-SF by 6.0 vs 0.5 points; maximum voluntary contraction 17.58→27.17 vs 16.32→17.70 cmH_2O; levator hiatus at Valsalva 18.30→15.52 cm^2 vs unchanged.
High et al. [12]	Cross-sectional survey; 314 athletes	CrossFit	PFDI-20, at least moderate bother required	UI 26.1% (SUI 15.6%, UUI 13.4%), prolapse symptoms 3.2%, faecal incontinence 6.0%; prevalence would have reached 52% had “somewhat bothered” counted as positive. Roughly half had attempted some therapy; one respondent had undergone surgery.

Study	Design and population	Sport / exposure	Outcome measure	Principal findings
Huebner et al. [15]	Cross-sectional; master weightlifters aged 30–79 y	Weightlifting	At least moderate UI	Moderate or more severe UI in 32.6%, above the 20–27% expected for comparable age groups. Higher body mass index, prior pregnancies and depressive mood raised the odds; age and menopausal status did not. Prior participation in high-impact sport was an independent risk factor, prior strength sport was not.
Lopes et al. [16]	Cross-sectional; 84 women aged 15–49 y, France	Weightlifting	Self-reported leakage during training (binary); Urinary Symptom Profile	Involuntary leakage in 60.7%, explained neither by sociodemographic, training, obstetric or surgical variables nor by the maximal load lifted, the use of a belt or the phase of breathing during exertion.
Louis-Charles et al. [1]	Clinical review with an illustrative case report (collegiate soccer player)	Female athletes, mixed sports	Clinical classification of pelvic floor dysfunction	Divides pelvic floor dysfunction into relaxing forms (urinary incontinence, faecal incontinence, prolapse) and non-relaxing forms (impaired evacuation, sexual dysfunction, pelvic pain), and notes that unfamiliarity among clinicians and non-specific symptoms frequently delay or prevent diagnosis. Cited here for terminology and for stress urinary incontinence being the most common subtype in athletes.
Pires et al. [23]	Pilot RCT; 14 elite nulliparous players allocated, 13 completed (intervention n = 7, control n = 6), mean age 22.3 y, Portugal	Volleyball	Modified two-hour pad test, King's Health Questionnaire, vaginal manometry	Sixteen-week periodised PFMT (awareness and stabilisation, then strength, then power with the "knack"): the proportion leaking fell from 71.4% to 42.9% under intervention but rose from 50.0% to 83.3% among controls. Between-group differences significant for urine loss ($p = 0.025$) and for maximum voluntary contraction ($p < 0.001$); vaginal resting pressure unchanged. All participants scored zero on the KHQ urinary domain at baseline despite 61.5% leaking on the pad test.
Rebullido et al. [18]	Systematic review; 9 studies of athletes under 19 y	Mixed; trampolining and rope skipping most affected	Mixed	UI prevalence ranged from 18% to 80%, mean 48.58%, indicating that symptoms may arise well before parity.
Rodríguez-López et al. [6]	Cross-sectional observational study; 754 elite athletes (455 female, 299 male), Spain	Mixed elite sports	ICIQ-UI-SF, 3IQ, ISI	UI in 33% of all athletes at a mean age of 23.75 ± 7.74 y; 45.1% of women versus 14.7% of men ($p < 0.001$), women being 5.45 times more likely to be affected. SUI in 59.9% of cases and moderate to severe UI in 30.9%; 22.7% had leaked during training, most often when jumping (40.5%). Prevalence varied according to the sport practised.

Study	Design and population	Sport / exposure	Outcome measure	Principal findings
Rodríguez-López et al. [10]	Cross-sectional; 211 female and 128 male national-level athletes, Spain	Track and field	ICIQ-UI-SF	UI 51.7% in women versus 18.8% in men; SUI predominant (64.4%); severity most often slight (66.7%). Among incontinent women, 78.0% leaked during training, chiefly on jumping tasks (50.6%), and a further 24.6% classified as continent by questionnaire nevertheless leaked in training. Specialisation was not related to UI overall; vertical jumpers showed significantly lower prevalence than horizontal jumpers, middle-distance runners and sprint/hurdles athletes, with the highest rates in horizontal jumps, then combined events and sprint/hurdles.
Sandwith and Robert [9]	Cross-sectional survey; 95 nulliparous varsity athletes, mean age 19.9 y	Rugby	Self-report	UI 54%; leakage reported by 90% during match competition and 88% when tackled, but by 41% during running and 18% during weight training. Each additional weekly training hour raised the risk by 15.3% (95% CI 2.9–29.3). Of 51 players with leakage, one had consulted a health professional, none had been treated and 18% were interested in treatment.
Skaug et al. [8]	Cross-sectional; 319 athletes	Artistic gymnastics, team gymnastics, cheerleading	ICIQ-UI-SF and self-report	UI 67.4%, SUI 63.0%, anal incontinence 84.0%; by discipline, team gymnasts 83.6%, artistic gymnasts 70.6%, cheerleaders 51.9%. Take-off (67%) and landing (60%) most provocative, running only 4%. Training on ≥ 4 days weekly: OR 2.31; straining to void: OR 2.66. 41.4% had never heard of the pelvic floor muscles, yet 73.7% would train them if shown how.
Skaug et al. [4]	Randomised crossover experiment; 47 nulliparous strength-trained women aged 18–35 y	Heavy weightlifting (back squat and deadlift, 4 × 4 at 75–85% 1RM) versus seated rest	Vaginal manometry; surface electromyography	No significant difference between conditions in pelvic floor muscle resting pressure, strength, endurance or resting activity after 60 minutes of heavy lifting. No correlation between pelvic floor muscle strength and absolute or relative one-repetition maximum.
Skaug et al. [26]	RCT; 47 women with SUI	CrossFit and functional fitness	ICIQ-UI-SF; manometry	Sixteen-week home programme (three daily rounds of 8–12 contractions held 6–8 s) versus instruction by email: ICIQ-UI-SF mean difference −1.4 (95% CI −2.6 to −0.2); 64% improved versus 8% (RR 7.96, 95% CI 2.03–31.19). No between-group difference in resting pressure, strength or endurance.
Wikander et al.	Cross-sectional survey;	Powerlifting	ISI and self-	Lifetime UI 48.8%, within the past three months

Study	Design and population	Sport / exposure	Outcome measure	Principal findings
[14]	480 women aged 20–71 y		report	43.9%; athletic incontinence 23.1%; 17.9% had been continent before taking up the sport. Deadlift most provocative (42.5%), then squat (36.3%); bench press least. Of those leaking on high-repetition sets, 79.3% only when heavy and 64.5% worse towards the end. Severity correlated with parity (τ = 0.227), age (τ = 0.179), competition total (τ = 0.105) and body mass index (τ = 0.089), not with years of training.
Wikander et al. [17]	Cross-sectional survey; 191 competitors, mean age 35.9 y	Weightlifting	ISI and self-report	Lifetime UI 36.6%, within the past three months 31.9%; athletic incontinence 16.2%. The squat was the lift most likely to provoke leakage and pulls the least; 57.1% leaked on high-repetition sets, 67.5% of them only when heavy. More frequent in training than in competition (25.7% vs 17.8%). No association with years of resistance training, years of weightlifting, body mass index or competition total.
Yang et al. [13]	Cross-sectional comparison; 105 CrossFit versus 44 aerobics participants	CrossFit versus aerobics	Self-report	SUI during exercise in 47.6% of the CrossFit group versus none of the aerobics group; among nulliparous participants 27.8% versus 0% ($p < 0.003$). Most frequent during double-unders (47.7%), rope skipping (41.3%) and box jumps (28.4%). Vaginal delivery the strongest independent predictor (OR 4.94, 95% CI 1.57–15.49). Coping: emptying the bladder beforehand 89.0%, dark clothing 51.4%, pelvic floor contractions 31.2%.

Source: own elaboration based on the publications included in the review.

Abbreviations: BMI - body mass index; CI - confidence interval; ICIQ-UI-SF - International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form; I-QoL - Incontinence Quality of Life questionnaire; ISI - Incontinence Severity Index; KHQ - King's Health Questionnaire; MUI - mixed urinary incontinence; NOS - Newcastle–Ottawa Scale; OR - odds ratio; PFDI-20 - Pelvic Floor Distress Inventory; PFMT - pelvic floor muscle training; PGI-I - Patient Global Impression of Improvement; POPDI-6 - Pelvic Organ Prolapse Distress Inventory; RCT - randomised controlled trial; RR - relative risk; SUI - stress urinary incontinence; UDI-6 - Urinary Distress Inventory; UI - urinary incontinence; UUI - urgency urinary incontinence; 1RM - one-repetition maximum.

4. Discussion

UI represents a highly prevalent pathology within sports characterised by abrupt, large-magnitude elevations in IAP. The specific biomechanical task - rather than the overarching sporting discipline - serves as the primary catalyst for leakage. Leakage clusters in actions generating steep pressure transients, such as landings, tackles, and heavy multi-joint lifts, a distribution consistent with IAP spikes exceeding the compensatory capacity of the PFM complex. Exposure appears to act in opposite directions at the two extremes of its range, since incontinence is also associated with restricted mobility in sedentary and older populations, where regular activity forms part of treatment rather than of the risk profile [29].

While an isolated bout of heavy training does not precipitate acute PFM fatigue [4], cumulative mechanical exposure correlates with symptom burden, although the supporting data are largely cross-sectional. The relevant temporal window for exposure assessment therefore appears to be the training macrocycle rather than the individual exercise bout, and the label of fatigue should not be attached to it until pelvic floor function has been tracked across a season. The fundamental pathophysiological deficit in athletic UI appears rooted in the diminished passive stiffness of the levator ani and associated connective tissues, rather than a lack of active contractile force [5]. Athletic mechanical loading and obstetric history appear to function as independent, additive stressors on these passive structural elements [11].

The pervasive under-reporting of athletic UI is primarily attributable to substantial deficits in anatomical education and health literacy, leading athletes to adopt concealment strategies in lieu of formal medical intervention. Crucially, therapeutic success appears to depend on professionally guided and adequately dosed PFMT rather than on continuous on-site supervision, since home-based programmes supported by instruction and periodic professional contact also produced improvement. The further step of integrating training into sport-specific loaded movement, and the prioritising of neuromuscular timing and anticipatory activation over maximal strength gains, are reasoned extrapolations from a non-athletic trial and from the dissociation between symptom relief and strength change in athletes; neither has yet been tested directly.

Case definition also shapes the apparent excess risk. As set out in Section 3.1, imposing a bother threshold brings the overall burden of pelvic floor symptoms in resistance-trained women close to general-population expectations, whereas counting any symptom roughly doubles the estimate [12].

One structural limitation of this evidence base deserves emphasis. Although the mismatch between IAP and pelvic floor counter-force provides the organising framework for this review, none of the included studies measured IAP directly during sporting tasks. The mechanism is inferred from the distribution of symptoms across movements, from morphological and dynamometric comparisons between continent and incontinent athletes, and from laboratory assessments of pelvic floor function after loading, rather than from simultaneous pressure recording. Instrumented measurement of IAP alongside pelvic floor dynamics during landing, tackling and maximal lifting therefore remains the single most informative gap to close.

The current literature base is further constrained by a heavy reliance on cross-sectional, self-reported survey data, with online convenience samples potentially introducing selection bias. It is also uneven in competitive standard: a substantial share of the participants train at high intensity without competing, so the transfer of these estimates to elite competitors rests on the assumption that mechanical exposure, rather than competitive status, is what drives risk. That assumption is consistent with the task-specific distribution of leakage reported throughout this review, but it has not been tested directly. Future research must prioritise prospective longitudinal cohorts and adequately powered randomised controlled trials, utilising outcome instruments specifically calibrated to the unique physiological demands of elite sports performance.

5. Conclusions

Urinary incontinence affects a substantial proportion of competitive female athletes across diverse disciplines, manifesting in both nulliparous adolescents and adult competitors. The specific biomechanical demands of the task govern clinical risk more robustly than the broad sport category, with high-impact landings, tackles, and heavy resistance lifts serving as primary triggers.

The pathomechanism is rooted in a biomechanical mismatch between transient IAP spikes and PFM counter-force, implicating deficits in passive tissue support rather than active force production. Symptom burden tracks cumulative loading across training cycles rather than acute fatigue within single sessions, although the mediating mechanism has not been measured directly.

Athletic mechanical exposure appears to act additively with obstetric history rather than through it. Professionally guided and adequately dosed PFMT reduces leakage in athletes, and improvement does not require gains in maximal strength; enhanced neuromuscular coordination and anticipatory timing are the plausible mediators, but they have not been demonstrated directly, and the case for embedding training within loaded movement rests on extrapolation from non-athletic trials. Athletic UI remains highly prevalent, chronically under-reported, and modifiable. Routine screening and sport-specific education should be integrated into standard athletic care.

Disclosure

Supplementary Materials

The study matrix is presented as Table 1 within the manuscript.

Author Contributions

Conceptualization: Weronika Ścieglińska, Martyna Czmiel, Antonina Radolińska; methodology: Weronika Ścieglińska, Antonina Radolińska, Monika Chlipała, Jakub Andrzejewicz ; investigation, Weronika Ścieglińska, Kamila Tarnawska; writing-original draft Weronika Ścieglińska; writing-review & editing: Weronika Ścieglińska, Monika Chlipała, Jakub Andrzejewicz

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The authors declare no conflict of interest.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

Artificial intelligence was used only to enhance language quality, correct grammar, and improve the academic English of the manuscript. All scientific interpretation, critical analysis, and conclusions are entirely the authors' own.

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